

A characterization of the megafauna at Davidson Seamount

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Abstract Seamounts offer hard substrate, complex habitat, elevated current velocities, and other features that allow for the existence of unique assemblages of organisms, often dominated by long-lived and fragile corals and sponges. Seamount faunas may have high rates of endemism with biogeographic patterns analogous to land-based island faunas. Seamount organisms, particularly long-lived deep-sea corals, are vulnerable to bottom trawling and other resource extraction techniques. Davidson Seamount, located 120 km southwest of Monterey, CA, USA, is an example of a relatively undisturbed and pristine seamount habitat. Volcanic in origin, Davidson Seamount was formed 12-16 million years ago atop a fossil spreading center, which produced a unique pattern of northeast trending ridges on the seamount. Remotely Operated Vehicle (ROV) dives at Davidson Seamount were conducted in 2000 and 2006 by a collaboration of scientists, resource managers and educators. Sixteen dives were annotated in detail using MBARI's Video Annotation Reference System (VARS), yielding more than 60,000 biological observations. One hundred and ninety organisms were identified to the lowest possible taxon. The distribution of organisms in relation to the bathymetric complexity of the seamount was analyzed using ArcGIS 9.1 and NOAA's Benthic Terrain Modeler (BTM) to relate faunal distribution to slope, aspect, and bathymetric position. Video transects completed in 2006 were analyzed to quantify species' density and richness. Several new species were observed and collected, and are currently being described by taxonomists. Results of this study indicate that corals and sponges may have species-specific depth distributions with little overlap of large habitat forming phyla. Moreover, substratum type, slope, and aspect are important in determining the distribution of some coral species. This baseline survey is valuable in describing the fauna of Davidson Seamount, has been used in developing essential fish habitat zones where trawling is regulated by the National Marine Fisheries Service, and will be critical in the final determination for the potential inclusion of the seamount as part of the Monterey Bay National Marine Sanctuary.

Davidson Seamount Quick Look

Distance from shore (km)	120
Depth at summit (m)	1256
Depth at foot (m)	3,656
Total height (m)	2,400
Length (km)	42
Calculated volume (Km ³)	320
Observation time (hrs of video)	110
Organisms observed	60,374
Organisms/m transected	2.5

Introduction The hard substrate, complex habitat, and modified hydrographic conditions found at many seamounts favor faunal assemblages that differ from those found on the flat, sediment-covered seafloor more typical of the deep-sea (4, 10). Additional factors contributing to the increased levels of abundance and diversity observed at some seamounts include elevated current velocities, entrapment of migrating zooplankton, and enhanced productivity due to the formation of Taylor columns (3, 4, 6, 9, 10). Due to these physical characteristics, biological communities found on seamounts are often very abundant, show high levels of diversity, and contain many endemic organisms (9). These unique communities are composed of corals, sponges, a variety of other invertebrates, as well as commercially important precious corals and seamount aggregating fish stocks. Vulnerable to trawling and other extractive techniques, many regions of the world have seen collapses in seamount aggregating fisheries and subsequent decimation of benthic invertebrate communities where deep-water trawls have been used (6).

Davidson Seamount is an enigmatic volcanic feature of intraplate origins estimated to have formed 12-16 million years ago atop older, oceanic crust. Similar in formation to other central California seamounts, Davidson Seamount has a distinctive northeast-to-southwest orientation (**Fig. 2**), indicating that it - like Rodriguez, Pioneer, and Guide Seamounts - may have formed astride an abandoned mid-ocean ridge system (2).

Methods Geological features and biological communities were observed using the Monterey Bay Aquarium Research Institute's (MBARI) ROV *Tiburon* (**Fig. 1**). Sixteen dives representing 110 hours of video from Davidson Seamount off the coast of California, USA (**Fig. 2**), were annotated using MBARI's Video Annotation and Reference System* (VARS, **Fig. 3**) to determine seamount community composition. Several hundred individual organisms were collected and subsequently sent to taxonomists for identification. MBARI's VARS was used to identify benthic and demersal megafauna to the lowest possible taxon. Each video observation was merged with ancillary data (geographic position, CTD, and camera information) within VARS. Thirty-five randomly selected video transects were recorded in 2006, which were used to help describe the community. Video observations were imported into ArcGIS® 9.1 and mapped along with high-resolution bathymetric data. A thirty-meter bathymetric grid of Davidson Seamount was analyzed using ArcGIS's Spatial Analyst extension to calculate aspect and slope. NOAA's ArcGIS extension, the Benthic Terrain Modeler (BTM), was used to calculate Bathymetric Position Index (BPI).

* The VARS components reference a knowledge database of over 3,800 biological, geological, and technical terms. The hierarchical structure of VARS allows for consistent and rapid classification, description, and complex querying of video observations. **VARS is open-source software. More information is available at <http://www.mbari.org/VARS/> or contact lonny@mbari.org.**

Fig. 2 Location of Davidson Seamount

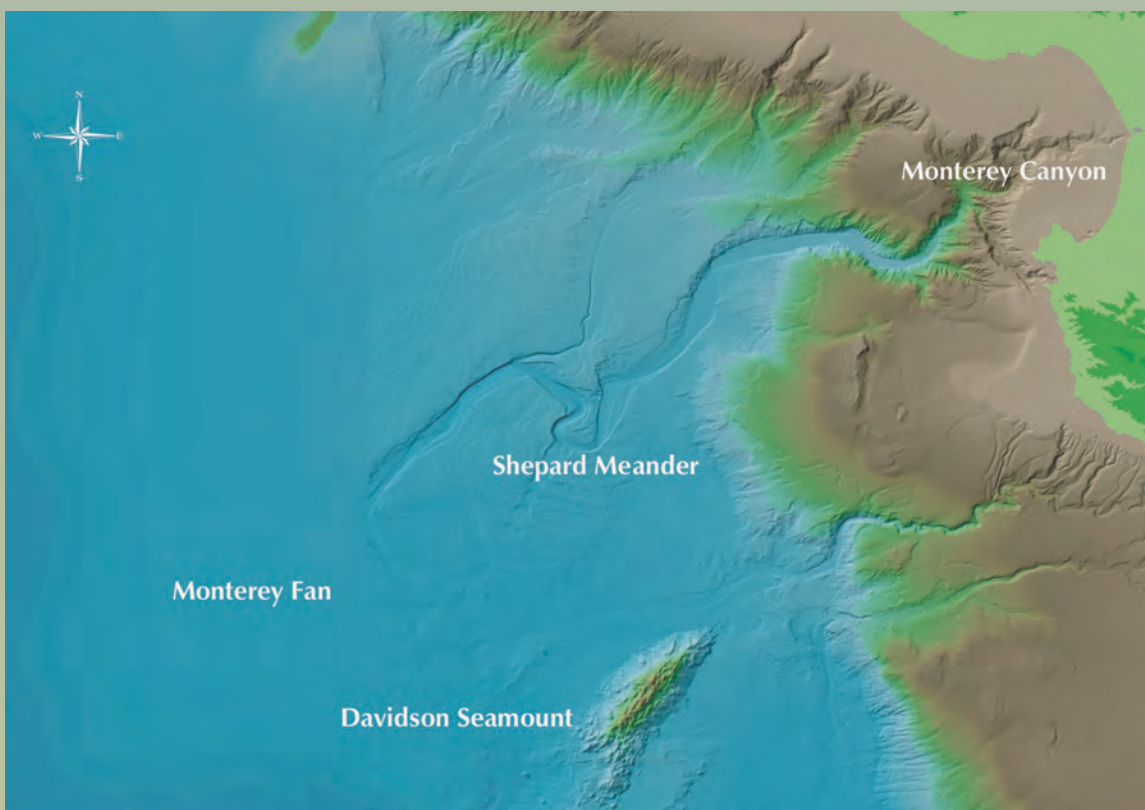
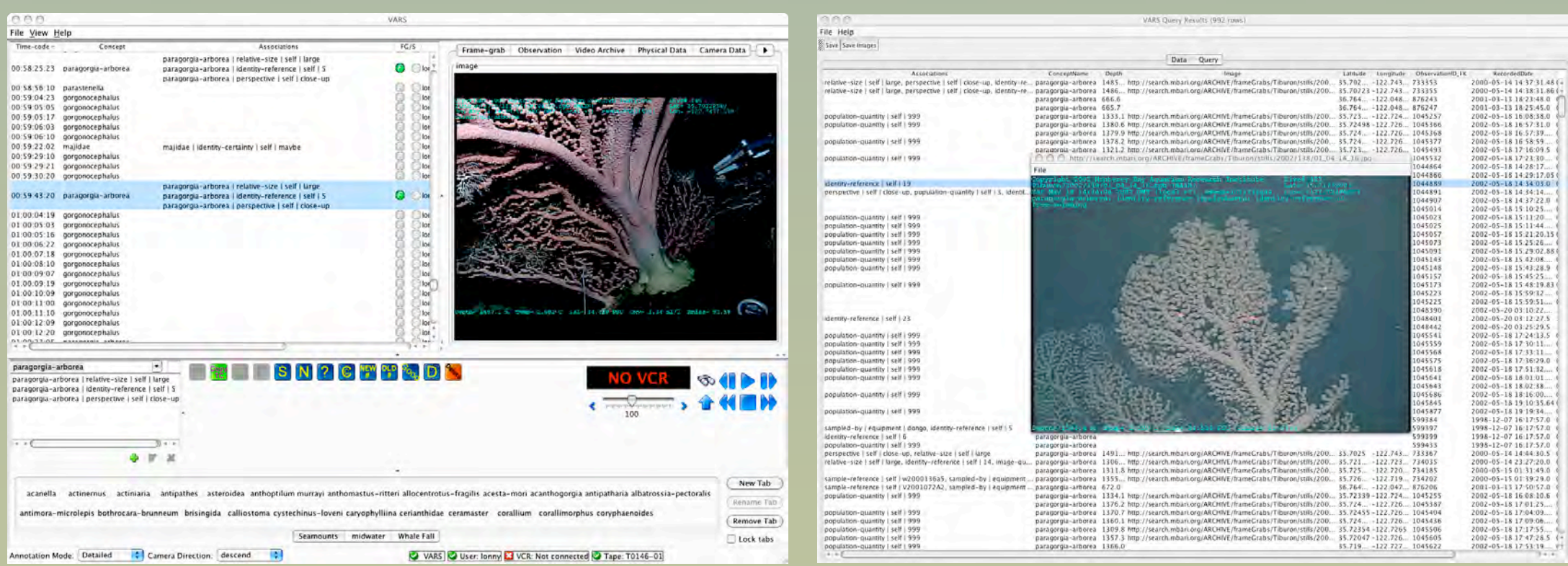


Fig. 3 MBARI's Video Annotation and Reference System (VARS)



Results Qualitative observations reveal that nearly 70% of the megafauna identified at Davidson Seamount are sessile (88% when functionally sessile organisms are included), 58% are suspension feeders, and ~30% are filter feeders. Dominant phyla include the Cnidaria (many of which are corals), Echinodermata, and Porifera (**Fig. 4**). Similar patterns were found using quantitative transect data.

Approximately 60,374 benthic invertebrates and demersal fishes were identified in this analysis, representing 190 species. An average of 2.5 organisms per meter transected were observed (range of .57 - 5.17 per meter transected). Transects varied in depth (-1280 m - ~3300 m) and length (35 m - 445 m). **Fig. 5A**

Twenty-five coral species were identified. *Paragorgia arborea* is the largest of the habitat-forming corals and it appears to have a narrowly defined depth range. Dense stands of *P. arborea* were found on the peaks of shallow cones, often overhanging sheer cliff faces. Other large habitat-forming corals, like the isidid *Keratoisid sp.*, appear to have a more broad depth distribution and were often found in saddles and on slopes. Interestingly, the average depth range of all but one coral is below the average depth of *P. arborea*. Corals in the family Primnoidae were numerous, although there are several species from this group which were difficult to distinguish in video and are currently under further review. Two new species of corals in the genus *Chrysogorgia* were collected and are currently being described. These two corals have similar depth distributions, though the flabellate form is more abundant in slightly deeper water. The precious coral, *Corallium sp.*, was also abundant below the *P. arborea* stands. **Fig. 5B**

Fig. 4 Motility, feeding style, and dominant phyla represented by video observations.

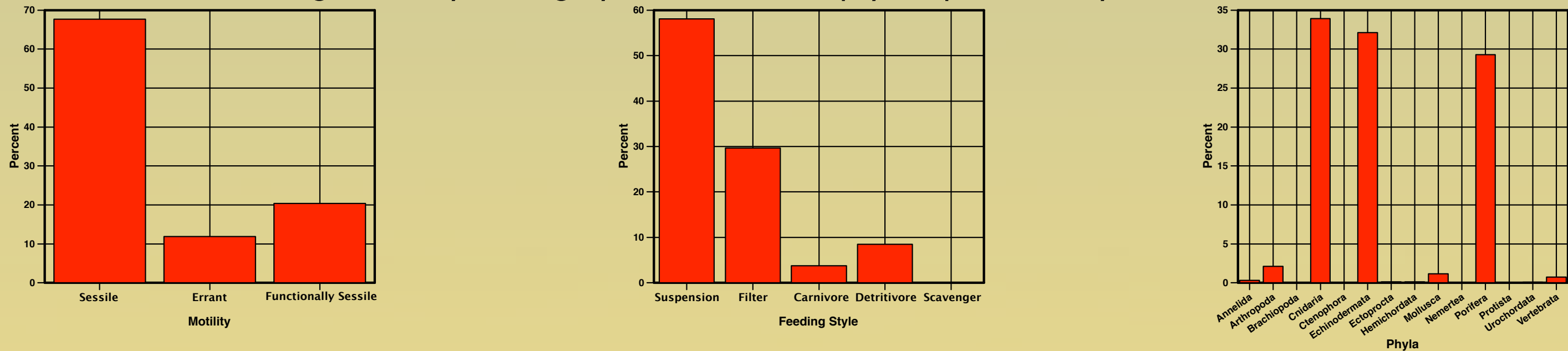
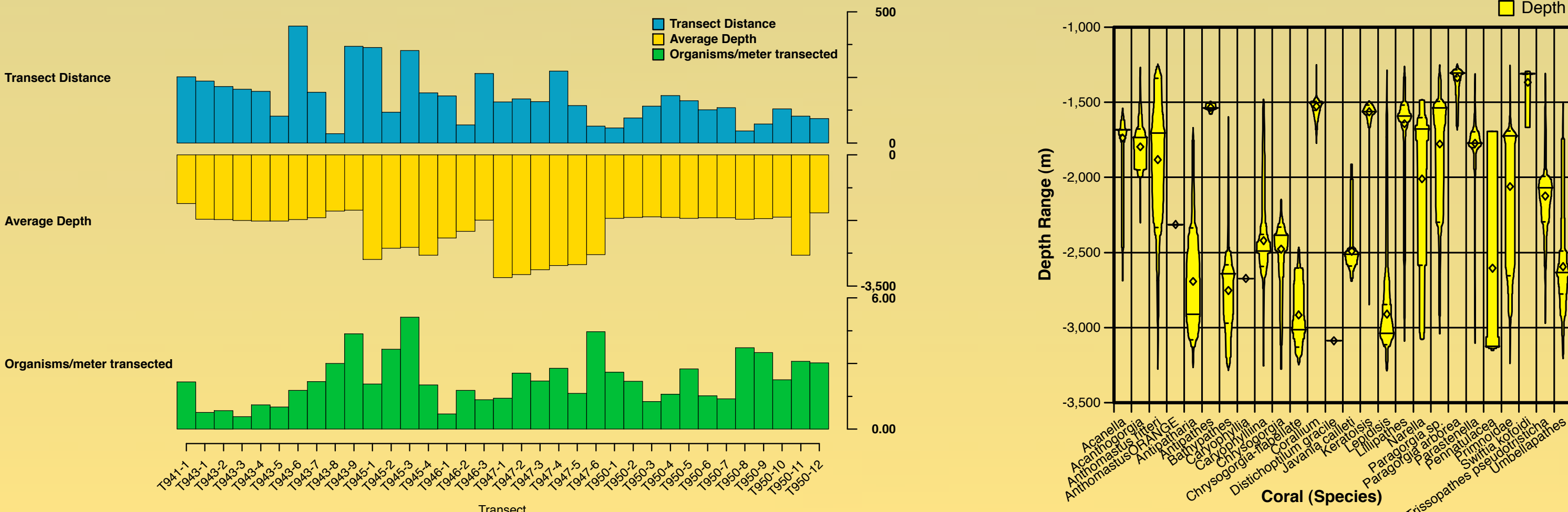
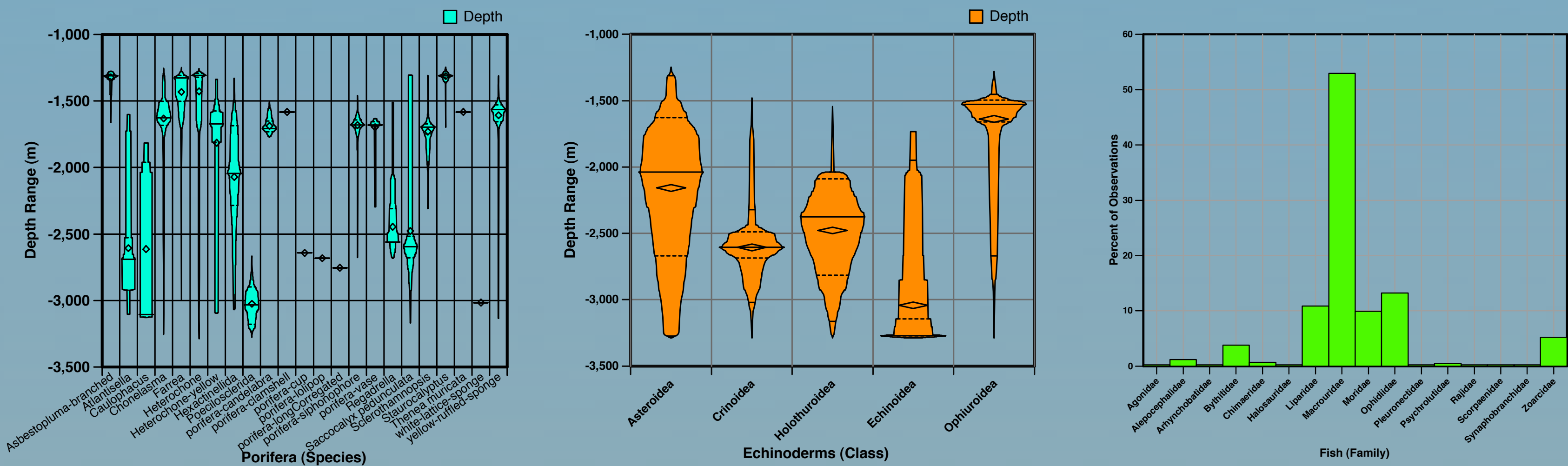


Fig. 5A (Left) Transect length, avg. depth, and organisms/meter transected. Fig. 5B (Right) Depth distribution of coral species.



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Fig. 6A (Left) Depth dist. of sponges. Fig. 6B (Center) Depth dist. of echinoderms. Fig. 6C (Right) Percent abund. of fish families.



Results continued Shallow “sponge reefs” were composed of *Farrea*, *Staurocalyptus*, and a new species of sponge in the genus *Asbestopluma*. This new species of *Asbestopluma* was sampled in 2006 and has a depth distribution which is similar to that of *P. arborea*. *Heterchone* and *Chonelasma* were also abundant at shallower depths. *Sclerothamnopsis* is another common sponge, but it has a more broad depth distribution. **Fig. 6A**

Among the Echinodermata the Ophiuroid *Gorgonocephalus* was extremely abundant at shallower depths, the Crinoid *Florometra seratissima* and several stalked crinoids in the families Hyocrinidae and Bathycrinidae were abundant in the middle depth ranges. A holothurian in the family Laetmogonidae was abundant, as were two other unidentified species of Holothuroidea. The echinoids *Tromikosoma panamense* and *T. hispidum* were common upon the sediment at deeper depths. Asteroids were fairly abundant at all depths. *Hippasteria spp.* were often observed feeding upon the abundant corals. **Fig. 6B**

Demersal fish were low in abundance when compared with invertebrates. Only 423 fish were identified in video of the 60,374 biological observations. Dominant fish families included the Macrouridae (~52%), Ophiidiidae (~14%), Bythitidae (11%), Moridae (10%), and Zoarcidae (~5%). These findings are consistent with other studies of deep-sea fish fauna off central California (1). **Fig. 6C**

Higher densities of organisms were found on northeast, east, and west facing slopes, **Fig. 7A**, with moderate (11° - 30°) and steep (>30°) declination, **Fig. 7B**. BPI values indicated that denser communities were found in areas of elevated relief. The BPI analysis gave results similar to those found in previous studies (3), **Fig. 7C**.

Fig. 7A Aspect analysis indicated higher densities of organisms were found on Northeast, East, West and South facing slopes. Not significant.

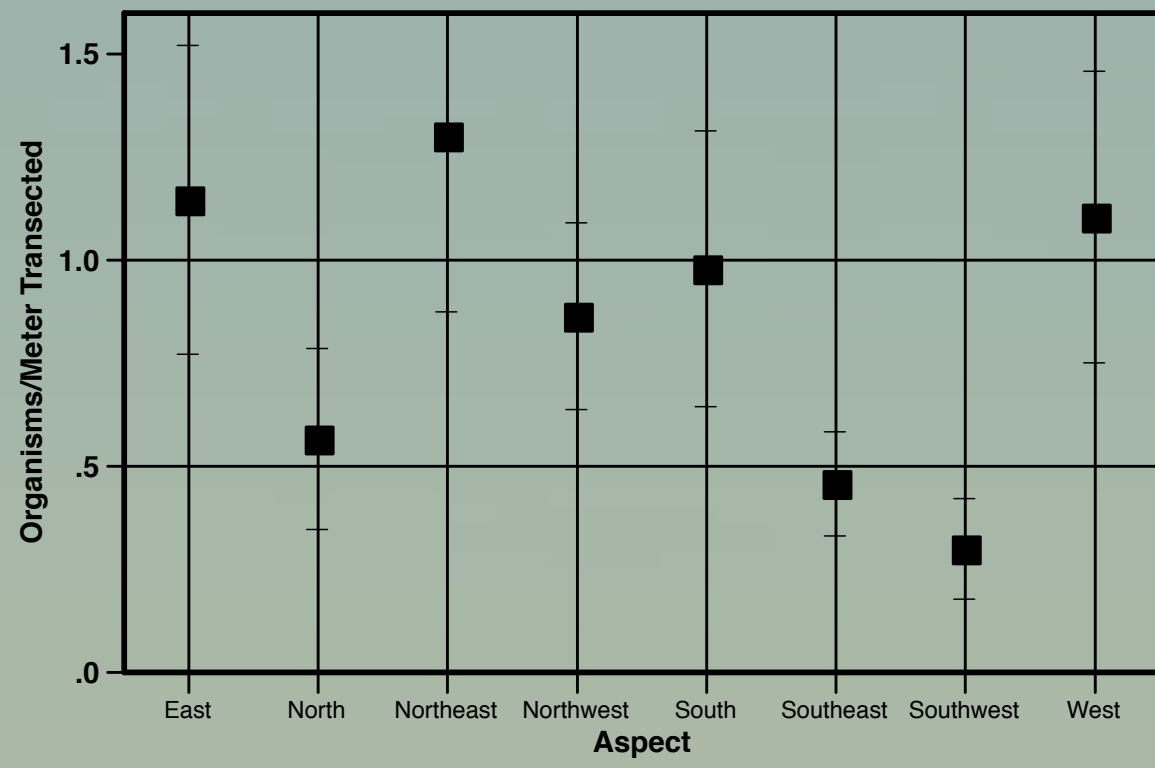


Fig. 7B Slope analysis indicated that higher densities of organisms were found on moderate (11° - 30°) and steep (> 30°) slopes. Not significant.

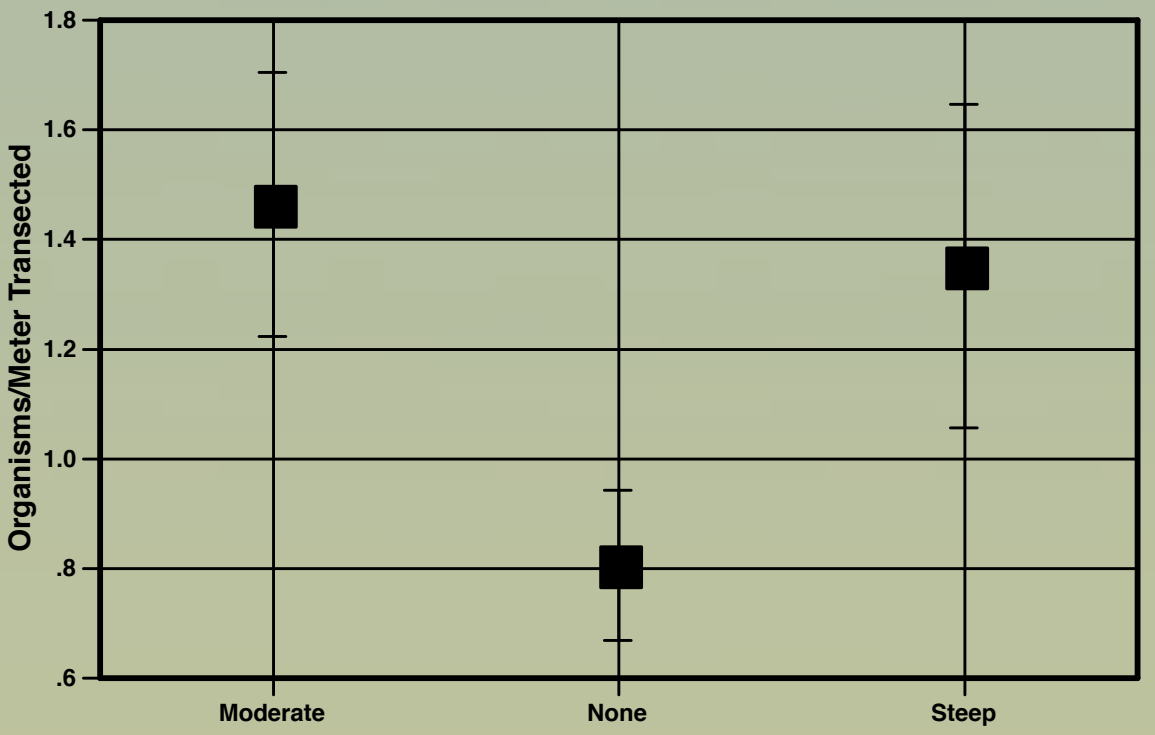
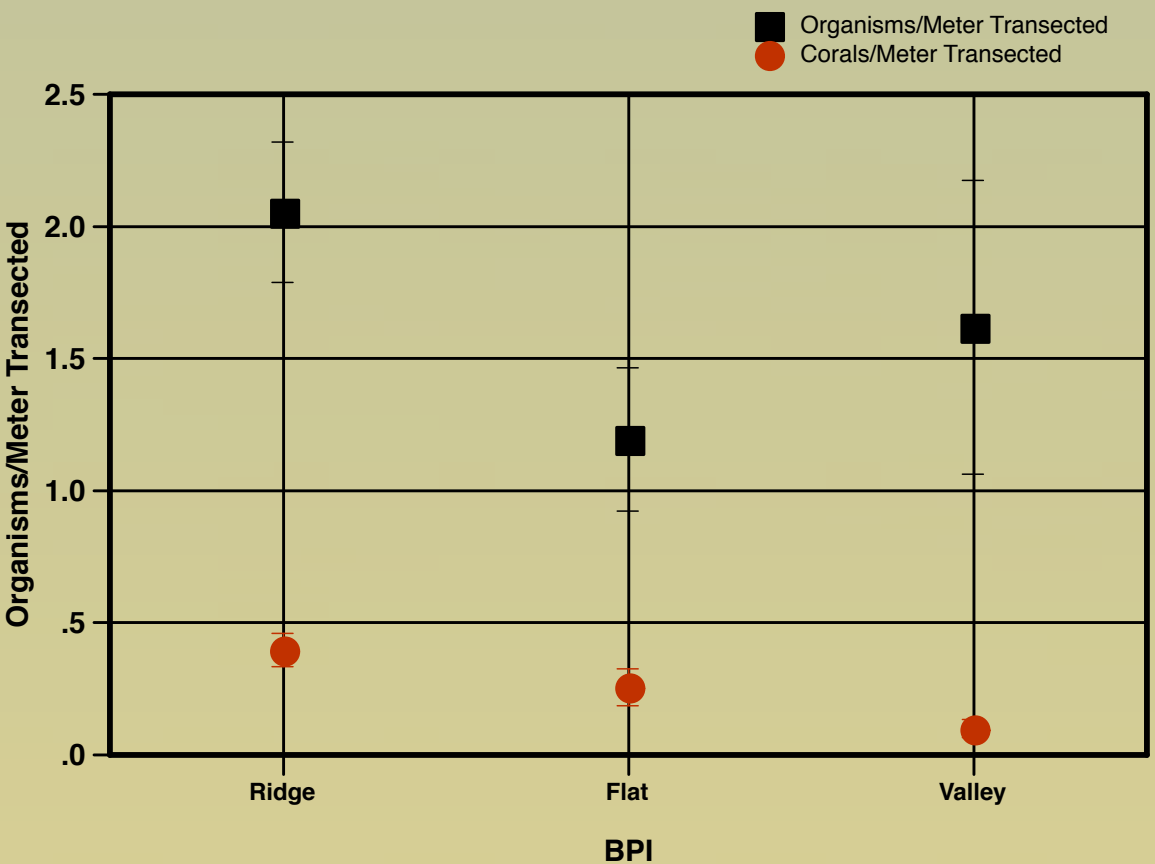


Fig. 7C BPI analysis indicated that higher densities of organisms were found in areas of elevated relief. For corals these results were significant, p=0.02



Conclusions

- The biological communities found at Davidson Seamount are composed mainly of sessile suspension and filter feeders.
- A community of large corals and several species of sponge compose a “peak” community, which is found between 1250 and 1500 meters. The occurrence of this community is most likely due to a combination of factors including reproductive strategies, substrate type, and elevated current velocities (6, 7, 9).
- Organisms found below the “peak” seem to have broader depths of occurrence, patchy distribution, and increased diversity.
- Fish abundance is low when compared to the other organisms observed, but these results are consistent with other reports for this region (1).
- Data from this research is being used to draft a management plan for incorporating Davidson Seamount into the Monterey Bay National Marine Sanctuary.
- VARS is a powerful tool for recording video observations and can be used to characterize unique habitats.

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